(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
8 July 2004 (08.07.2004)

PCT

(10) International Publication Number
WO 2004/057252 A1

(51) International Patent Classification[7]: F25J 1/02, 3/06, B63B 22/02

(21) International Application Number: PCT/NO2003/000441

(22) International Filing Date: 23 December 2003 (23.12.2003)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
20026189 23 December 2002 (23.12.2002) NO

(71) Applicant *(for all designated States except US)*: **INSTITUTT FOR ENERGITEKNIKK** [NO/NO]; P.O. Box 40, N-2027 Kjeller (NO).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **BENCZE, Istvan** [NO/NO]; Parkv. 2, N-1550 Hølen (NO). **BOSIO, jan** [NO/NO]; Benneches g 1, N-0169 Oslo (NO). **ENDRESTØL, Guttorm, O.** [NO/NO]; Prost Petersens v 77, N-2019 Skedsmokorset (NO). **SIRA, Terje** [NO/NO]; Lønneveien 120, N-2020 Skedsmokorset (NO). **THOMASSEN, Dag** [NO/NO]; Granåsen 12, N-1900 Fetsund (NO).

(74) Agent: **J.K. THORSENS PATENTBUREAU A/S**; P.O. Box 9276 Grønland, N-0134 Oslo (NO).

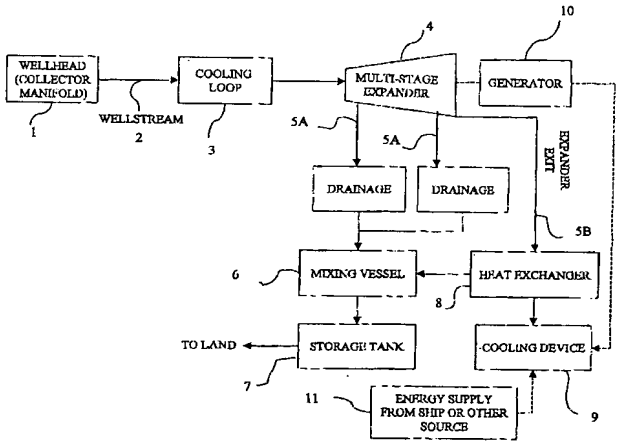
(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States *(regional)*: ARIPO patent (BW, GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: METHOD AND SYSTEM FOR CONDENSATION OF UNPROCESSED WELL STREAM FROM OFFSHORE GAS OR GAS CONDENSATE FIELD



(57) Abstract: In a method of condensing an unprocessed well stream from an offshore gas or gas condensate field the well stream taken from one or more wellheads (1) is cooled (3) and directly expanded (4), isentropically, or near isentropically, to a state in which the pressure is close to that of a storage tank (7). Part of the well stream is condensed and condensed fractions thereof is drawn off the expander and fed to the storage tank along with condensation products (5B) from the exit of the expander. Hence, without any preprocessing, a condensed well stream product is produced which comprises a mixture of liquids and solids which are collected in the storage tank (7) for transport therefrom to land. A system for carrying out the method is also disclosed. The invention makes the condensation of an unprocessed well stream possible without any preprocessing thereof, such as extraction of solid particles, e.g. sands, removal of water, cleaning or drying. Thus, by means of the invention smaller gas or gas condensate fields can be developed in a more cost efficient way.

WO 2004/057252 A1

METHOD AND SYSTEM FOR CONDENSATION OF UNPROCESSED WELL STREAM FROM OFFSHORE GAS OR GAS CONDENSATE FIELD

Technical Field

The present invention relates to a method of condensing an unprocessed well stream from an offshore gas or gas condensate field for the purpose of producing a condensed well stream product that can be collected in a storage tank at sea for transport therefrom to land.

Background Art

The development of offshore gas or gas condensate fields of smaller size has often been considered as unprofitable because the costs of bringing the product therefrom onto the market would have been to high. Using technologies known thus far often requires complicated preprocessing and production plants for the preparation of products which are more suitable for the transport away from an exploitation field than an unprocessed well stream. In particular it has been common practice to separate liquids and solid particles, and any heavier hydrocarbons, from the well stream and then to process further constituents of the well stream individually, such as the extracted gas.

An example of the prior art is described in NO Patent No. 180 469 which relates to a method and system for offshore production of liquefied natural gas (LNG), wherein the well stream is supplied from a subsea production plant to a pipeline, in which it is cooled by the surrounding sea water. Then the well stream is supplied to a conversion plant provided on a ship, wherein liquids and solid particles are extracted and at least a part of the remaining gas is converted to liquid form for the transfer to storage tanks on board the ship.

Another example of the prior art is described in US Patent No. 6 378 330 which relates to a process for making pressurized liquefied natural gas (PLNG) from a gas stream rich in methane, wherein gas is condensed by first being cooled and then expanded. If the stream of natural gas contains heavier hydrocarbons which may freeze out during the liquefaction, they must, however, be removed prior thereto.

Furthermore, NO Patent No. 177 071 describes a method of dealing with petroleum gas from an oil or gas production field comprising ethane and heavier hydrocarbons, wherein liquids and solids are separated from a well stream and the gas of the well stream is

dried, cooled and possibly processed further prior to condensation and the placement of the condensed gass in storage tanks. In US Patent No. 6 094 937 it is described a method of liquefaction and/or conditioning of a compressed gas/condensate from a petroleum deposit, especially a compressed gas/condensate flow which has been separated from a crude oil extracted from an offshore oil field.

Using the technologies known thus far and disclosed in the above publications, the feed is in each case subjected to a preprocessing prior to the condensation process itself. In particular it is presupposed that liquids and solids, and any heavier hydrocarbons, are separated in advance. The known techniques referred to all focus on making liquefied natural gas of some quality or other, that may be brought ashore from a location at sea. None of the publications is seen to be concerned with the other constituents of the well stream. According to NO Patent No. 180 469, for example, the extracted liquids and solids are transferred to a container with no indication as to what is done with the contents of the container when it is full.

Threrefore, in such offshore production of liquefied natural gas, there may be a problem in respect of such components that traditionally are extracted, such as oily sands and water, which must be transported away, or otherwise be deposited *in situ*. Common to the approaches disclosed in the publications above is that they also require costly processing plants, some times drier/dehydration and regenerator/cleaning systems, too.

Thus, there is a need for a technological solution, by means of which smaller gas or gas condensate fields can be developed in a more cost efficient manner than by the technologies known so far.

Disclosure of Invention

The invention relates to a method of condensing an unprocessed well stream from an offshore gas or gas condensate field, wherein the well stream is fed from one or more wellheads through a pipe coil in the sea to be cooled by the surrounding water to a temperature just above the hydrate temperature of the well stream, and then feeding the cooled well stream to an expander for the expansion thereof.

On this principle background of prior art, the method according to the invention is characterized in that the unprocessed well stream is expanded isentropically, or near isentropically, to a state in which the pressure is close to that of a storage tank, such

that part of the well stream is condensed, and condensed fractions of the prior to the expansion, unprocessed well stream are drawn off the expander and fed to the storage tank along with condensation products from the exit of the expander, thereby producing, without any preprocessing, a condensed well stream product made up of a mixture of liquids and solids which are collected in the storage tank for transport therefrom to land.

The invention also relates to a system for carrying out the method according to the invention, such as indicated in patent claim 8 appended hereto, and preferred embodiments of the invention are indicated in respective ones of the dependent claims.

In the method according to the invention there is no need for the well stream to undergo any form of preprocessing, not even separation. Hence, a processing plant for the implementation of the method may be correspondingly simplified. The method makes it possible to condense an unprocessed well stream into a product comprising a mixture of liquids and solids, *i.e.* a liquefied unprocessed well stream (LUWS), without any preprocessing of the feed, such as extraction of solid particles, *e.g.* sands, and removal of water, cleaning and drying.

In the context of the present invention, as it would be known in the present professional area, the expression "unprocessed well stream" is intended to mean the mixture that flows out of a well through a wellhead, or more wellheads joined in a manifold, under the normal production from a gas or gas condensate field without any preprocessing being undertaken, and of a composition, pressure and temperature that may vary from one field to another. An unprocessed well stream as just defined, may contain all possible components and phase mixtures that normally occur when producing from a gas or gas condensate field. Such a flow of fluids is the feed to the process of the invention.

Brief Description of Drawings

An example of how to carry out the method according to the invention is given below by reference to the accompanying drawings, wherein:

Figure 1 is a block diagram showing an embodiment of the invention, in which the final cooling is done by means of a heat exchanger and a cooling device included in the process chain,

Figure 2 is a block diagram showing an alternative embodiment of the invention, in which the final cooling is done by means of a cooling device in the form of a rechargeable, portable cooling energy accumulator,

Figure 3 is an example of a pressure *vs.* enthalpy diagram showing the changes in the state of a well stream during a process according to the invention, and

Figure 4 is a diagram that based on process pressure illustrates the difference between a process performed according to the invention and a conventional condensation process.

Modes for Carrying Out the Invention

Figure 1 is a block diagram showing an embodiment of the invention, which is adapted to a process whereby an unprocessed well stream from a wellhead or well manifold is condensed by expansion and led to a storage tank, and the final cooling is done by means of a heat exchanger and a cooling device included in the process chain.

This embodiment of the invention illustrated in Figure 1 is intended for being used for the condensation of an unprocessed well stream from an offshore gas or gas condensate field. Through a wellhead 1, or a plurality of wellheads interconnected at a collector manifold, gas is produced, the composition, pressure and temperature of which depending on the field concerned. Without any preprocessing or treatment the well stream 2 is led through a cooling loop 3 such that the temperature of flow is kept a few degrees, *e.g.* 5°C, above the hydrate forming temperature of the well stream. From the cooling loop 3, which may take the form of a coiled pipe on the sea bed, the well stream is fed to a multi-stage expander means 4 which may be a dynamic expander, or the combination of a static and a dynamic expander.

An example of a conceivable dynamic expander suitable for utilization in the expansion process which tolerates the formation of ice and the wear and tear due to ice particles is described in US Patent No. 4 771 612, whereas examples of conceivable static expanders for the same purpose are described in each of US Patents No. 5 083 429 and 6 372 019. It also feasible to use some other expanders which are suitable for the purpose.

In the expander 4 the pressure and temperature is gradually lowered such that parts of the well stream is condensed, and liquids are drawn off through draining outlets 5A. The condensation products from the drains are fed to a mixing vessel 6 which also is supplied with the condensation products from the exit of the expander 5B which on their part is cooled to a desirable temperature prior to the mixing by means of a system comprising a heat exchanger 8 and a cooling device 9 included in the process chain. Thus, the product then accumulating in the storage tank 7 is a condensed well stream

product, *i.e.* a liquefied unprocessed well stream (LUWS) made up of a mixture of condensation products from each of the draining outlets 5A and the expander exit 5B.

Figure 2 is a block diagram showing an alternative embodiment of the invention, in which the process is the same as that in Figure 1 but where the final cooling prior to the arrival of the condensation products at the mixing vessel 6 is done by means of a cooling device which in this case is in the form of a cooling energy accumulator 9 adapted to be recharged ashore and transported to the gas or gas condensate field.

A process according to the method of the invention is now to be explained with reference to Figure 3 which gives an example of a pressure *vs.* enthalpy diagram showing the changes in the state of a well stream during the process. In the pressure *vs.* enthalpy diagram shown the point labelled ⑥ indicates the state of the well stream at the wellhead 1. The well stream emerging from a gas or gas condensate field is at a high temperature, *e.g.* of 90°C, and a high pressure, which in the diagram shown equals 200 bar. Through the cooling loop 3 the well stream is cooled to a temperature just above the hydrate temperature, corresponding to state ⑤ in Figure 3. Then the well stream is expanded isentropically, or near isentropically, to a state ③ in which the pressure is close to that of a storage tank 7.

During the expansion process ⑤ → ③ part of the well stream condenses and the condensed fraction is led to the storage tank 7 through draining outlets arranged on the expander 4 at the same time as energy is released which is convertible to electric power, as indicated by a generator 10 in Figures 1 and 2, approximately corresponding to the shift in enthalpy $h_5 - h_3$. To cause the well stream to become a mixture of liquids and solids the well stream is cooled from state ③ to state ⑦. For this cooling the energy released from the expansion ⑤ → ③ is used in addition to an external energy source 11 where required, *e.g.* from a ship. In this example, the pressure in the storage tank is chosen to be 15 bar but it may be set as low as 1 bar, if this is practical. In such an example the expansion would proceed from ⑤ → ② and subsequently the mixture would be cooled from ② → ① after the expansion process.

The difference between the process according to the invention and the conventional LNG processes is elucidated in Figure 4. According to the invention the condensation

takes place along the solid linje (a) in a fully continuous process from wellhead or well-head manifold to the storage tank 7. On the contrary, the conventional condensation processes take place in a step by step manner and the well stream must undergo a comprehensive preprocessing including separation, drying, cleaning corresponding to points 2 and 4 i Figure 4, and recompression corresponding to points 3 and 5 in Figure 4, several times, before it arrives at the storage tank.

One advantage of the invention is that the unprocessed well stream is used as feed to the process. This means use of fewer elements of equipment and, hence, weight and space savings on platforms and production ships at sea, resulting in considerable cost reductions compared to common condensation processes. In addition, the invention represents a potential for saving energy compared to known LNG production processes since there will be fewer processing steps and, therefore, a reduced need for extra pressure increasing capacity, due to a more efficient utilization of the inherent energy at the wellhead or wellhead manifold.

From Figure 3 the energy balance of a condensation process also appears:

- the process according to the invention releases energy corresponding to $h_5 - h_3$, whereas
- a conventional process for liquefaction of natural gas releases energy corresponding to $h_4 - h_3$, such that
- the energy saving that this invention may give, is $h_5 - h_4$.

This situation is further demonstrated in Table 1 below which contains results of three simulated isentropic expansion processes under ideal theoretical conditions at a starting pressure and temperature of 200 bar and 20°C at the well manifold and ending pressures of 1 bar, 15 bar, and 40 bar, respectively. A pressure of 40 bar represents a typical pressure whereat conventional processes carry out separation and cleaning of the gas, and 1 bar and 15 bar represent alternative pressures in the storage tank.

Table 1 relates to an isentropic expansion process under ideal theoretical conditions for a gas comprising about 80% methane, 5% ethane, 2% propane, 2% N_2, 5% CO_2, and 6% C_{3+}, and is based on a starting condition corresponding to state ⑤ in Figure 3. The table indicates the values of available energy in the expansion process and the required

cooling needed for the condensation of all the fluid, after the expansion, into liquids, for ending conditions corresponding to states ②, ③ og ④ in Figure 3, respectively.

Tabell 1

State (see Fig. 3)	Pressure (bar)	Temp. (°C)	Gas (% weight)	Liquid (% weight)	Free energy (kJ/kg)	Cooling need (kJ/kg)
②	1	-152,7	57,06	42,92	257	316
③	15	-93,4	64,52	35,48	147	287
④	40	-59,5	70,26	29,74	99	238

The *Gas* column indicates the gas percentage by weight after the drawing off of liquid in the expansion process.

The *Liquid* column indicates the liquid percentage by weight at the drawing off of liquid.

The *Free energy* column indicates the available free energy in the expansion process.

The *Cooling need* column indicates the cooling required to make the rest of the gas liquefied.

From the table it can be seen that the energy saved by using the method according to the invention amounts to 99 kJ/kg compared to a conventional process. A conventional process may utilize 33% and 61% of the available free energy when the pressure in the storage tank equals 15 bar and 1 bar, respectively. A process according to the present invention, however, is able to utilize all the free energy of the well stream.

CLAIMS

1. A method of condensing an unprocessed well stream from an offshore gas or gas condensate field, wherein the well stream is fed from one or more wellheads (1) through a cooling loop (3) in the sea to be cooled by the surrounding water to a temperature just above the hydrate temperature of the well stream, and then feeding the cooled well stream to an expander (4) for the expansion thereof,
the method being **characterized in that** the unprocessed well stream is expanded isentropically, or near isentropically, to a state in which the pressure is close to that of a storage tank (7), such that part of the well stream is condensed, and condensed fractions (5A) of the prior to the expansion, unprocessed well stream are drawn off the expander and fed to the storage tank along with condensation products (5B) from the exit of the expander, thereby producing, without any preprocessing, a condensed well stream product made up of a mixture of liquids and solids (LUWS) which is collected in the storage tank (7) for transport therefrom to land.

2. A method according to claim 1, wherein the condensation products from the exit of the expander is cooled to a desired temperature prior to being fed to the storage tank (7), by means of a heat exchanger (8) and cooling device (9).

3. A method according to claim 2, wherein energy generated in the expander (4) by direct condensation therein of part of the well stream, is utilized in the cooling device (9).

4. A method according to claim 2, wherein the cooling device takes the form of a cooling energy accumulator (9) adapted to be recharged at another location and transported to production site.

5. A method according to claim 1, wherein the storage tank pressure is set between 10 and 20 bar.

6. A method according to claim 1, wherein the storage tank pressure is set close to atmospheric pressure.

7. A method according to claim 1, wherein the expander (4) is made up of a combination a static and a dynamic expander, the latter having one or more stages.

8. A system for carrying out the method according to any one of the claims above, the system comprising:

- an expander (4) in which the expansion of the unprocessed well stream is effected isentropically, or near isentropically, to a state in which the pressure is close to that of a storage tank (7), the expander being provided with a plurality of draining outlets (5A),
- a heat exchanger (8) for the receipt of condensation products (5B) from the exit of the expander,
- a mixing vessel (6) for the receipt of condensed fractions of the well stream taken from the expander through its draining outlets and for the receipt of condensation products which have passed through the heat exchanger,
- a storage tank (7) for storing a mixture of liquids and solids (LUWS) received from the mixing tank, for transport therefrom to land.

9. A system according to claim 8, further comprising a cooling device (9) associated with the heat exchanger (8), and where energy generated in the expander (4) by direct condensation therein of part of the well stream, is utilized in the cooling device (9).

10. A system according to claim 9, wherein the cooling device (9) takes the form of a cooling energy accumulator adapted to be recharged ashore and transported to the offshore production field.

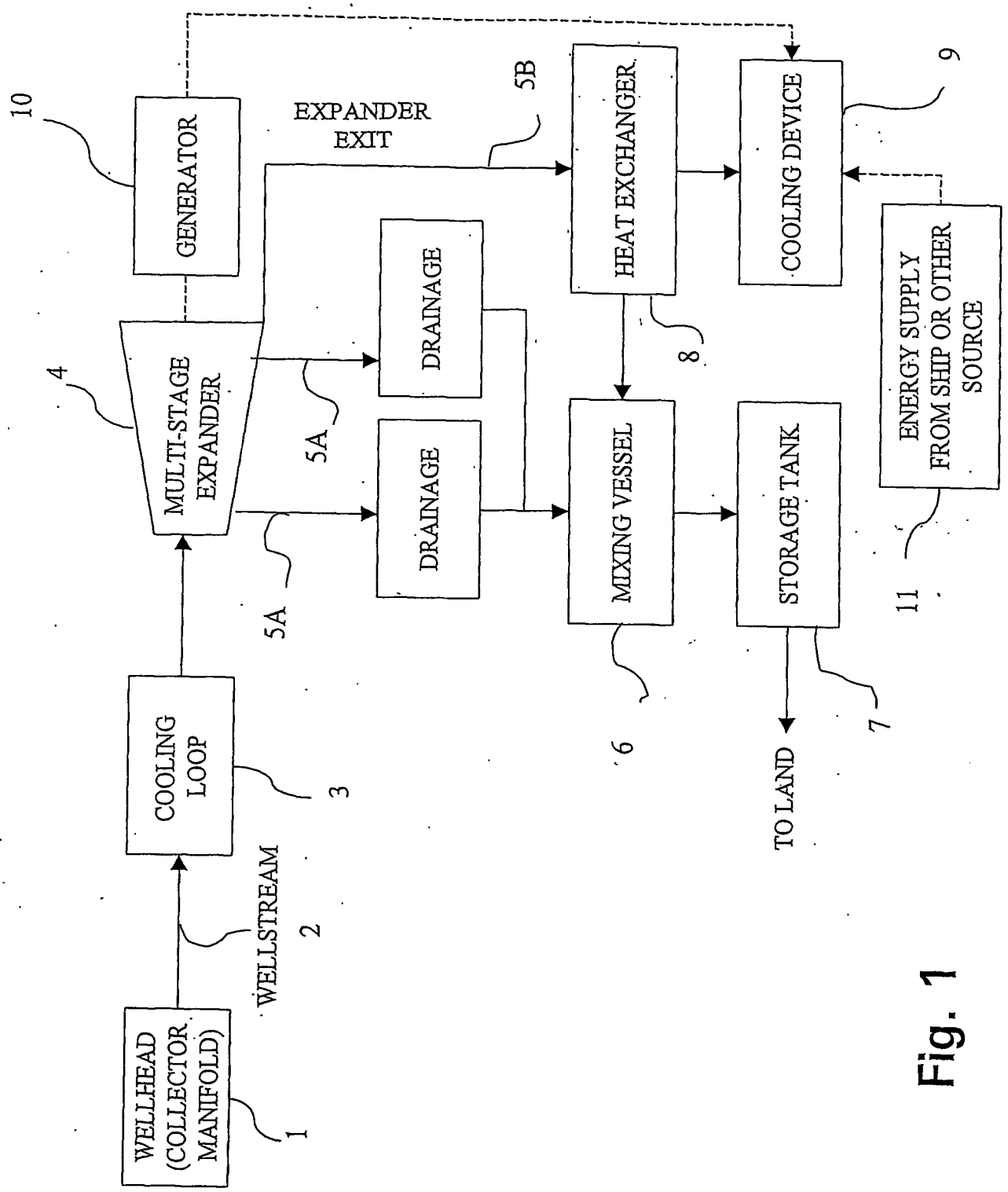

WELLHEAD (COLLECTOR MANIFOLD)
1
WELLSTREAM
2
COOLING LOOP
3
MULTI-STAGE EXPANDER
4
5A
5A
DRAINAGE
DRAINAGE
EXPANDER EXIT
5B
GENERATOR
10
HEAT EXCHANGER
8
COOLING DEVICE
9
ENERGY SUPPLY FROM SHIP OR OTHER SOURCE
11
MIXING VESSEL
6
STORAGE TANK
7
TO LAND

Fig. 1

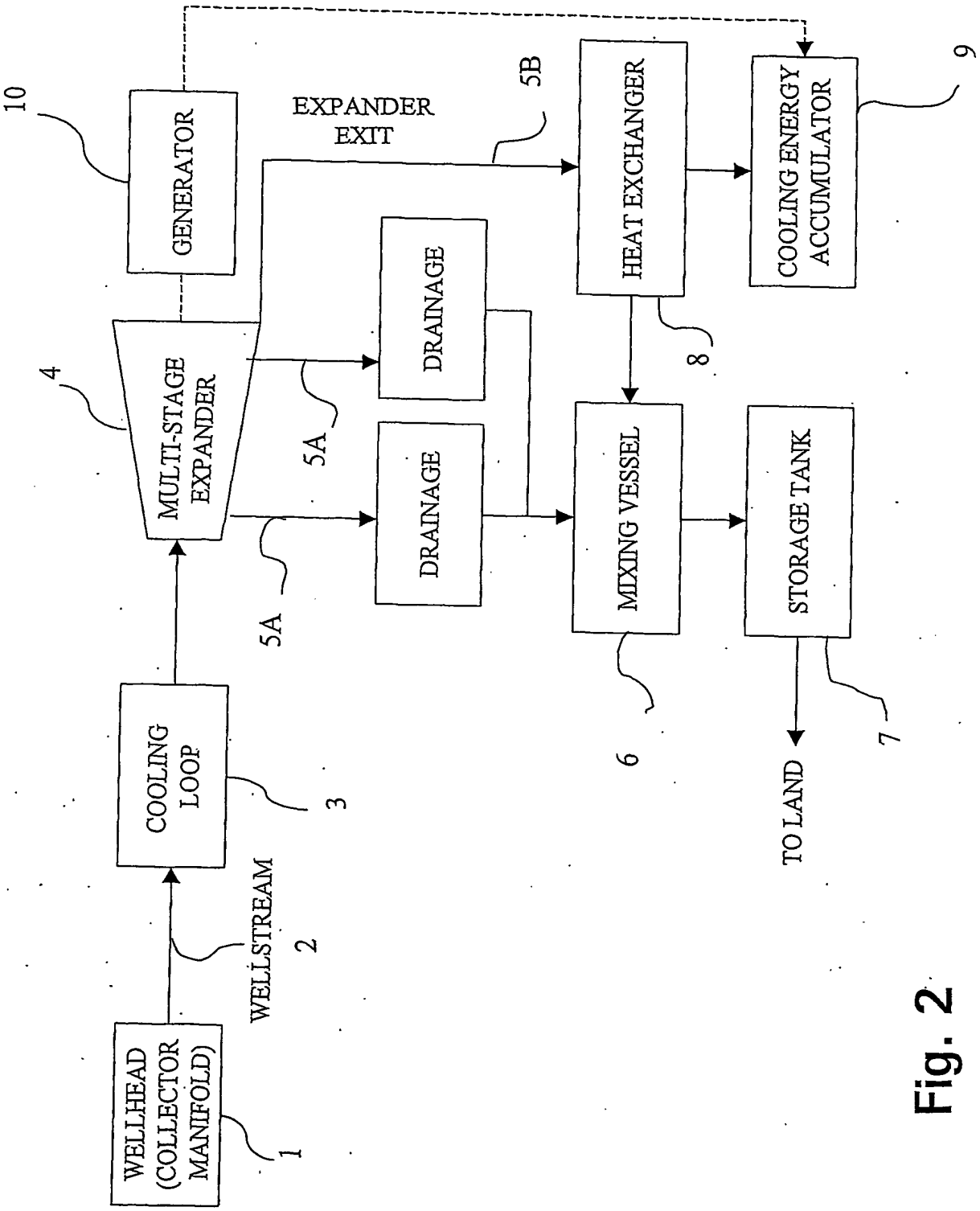

WELLHEAD (COLLECTOR MANIFOLD)
1
WELLSTREAM
2
COOLING LOOP
3
MULTI-STAGE EXPANDER
4
5A
5A
DRAINAGE
DRAINAGE
EXPANDER EXIT
5B
GENERATOR
10
HEAT EXCHANGER
8
COOLING ENERGY ACCUMULATOR
9
MIXING VESSEL
6
STORAGE TANK
7
TO LAND

Fig. 2

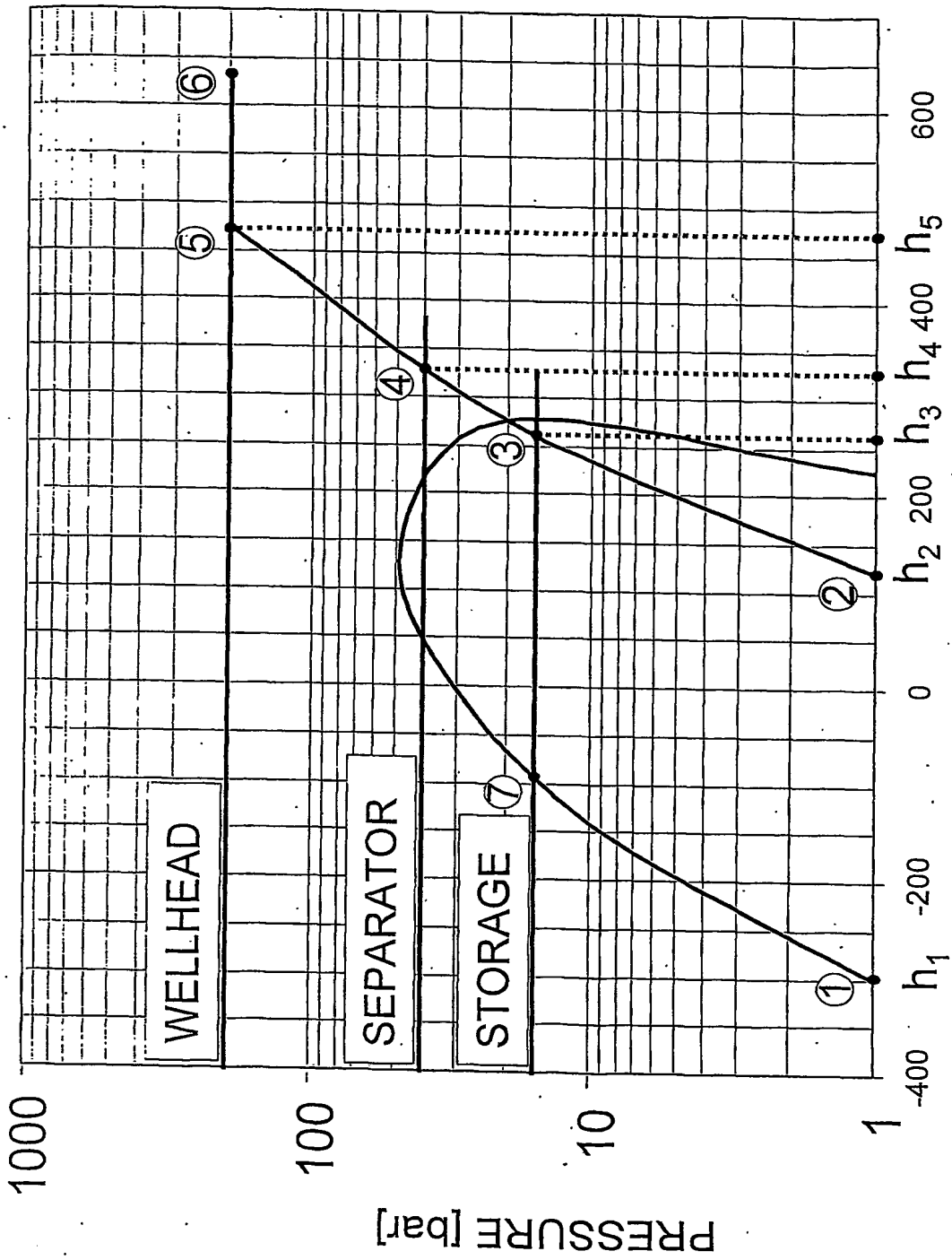

WELLHEAD
SEPARATOR
STORAGE
1
2
3
4
5
6
7
1000
100
10
1
PRESSURE [bar]
-400
-200
0
200
400
600
ENTHALPY [kJ/kg]
h1
h2
h3
h4
h5

Fig. 3

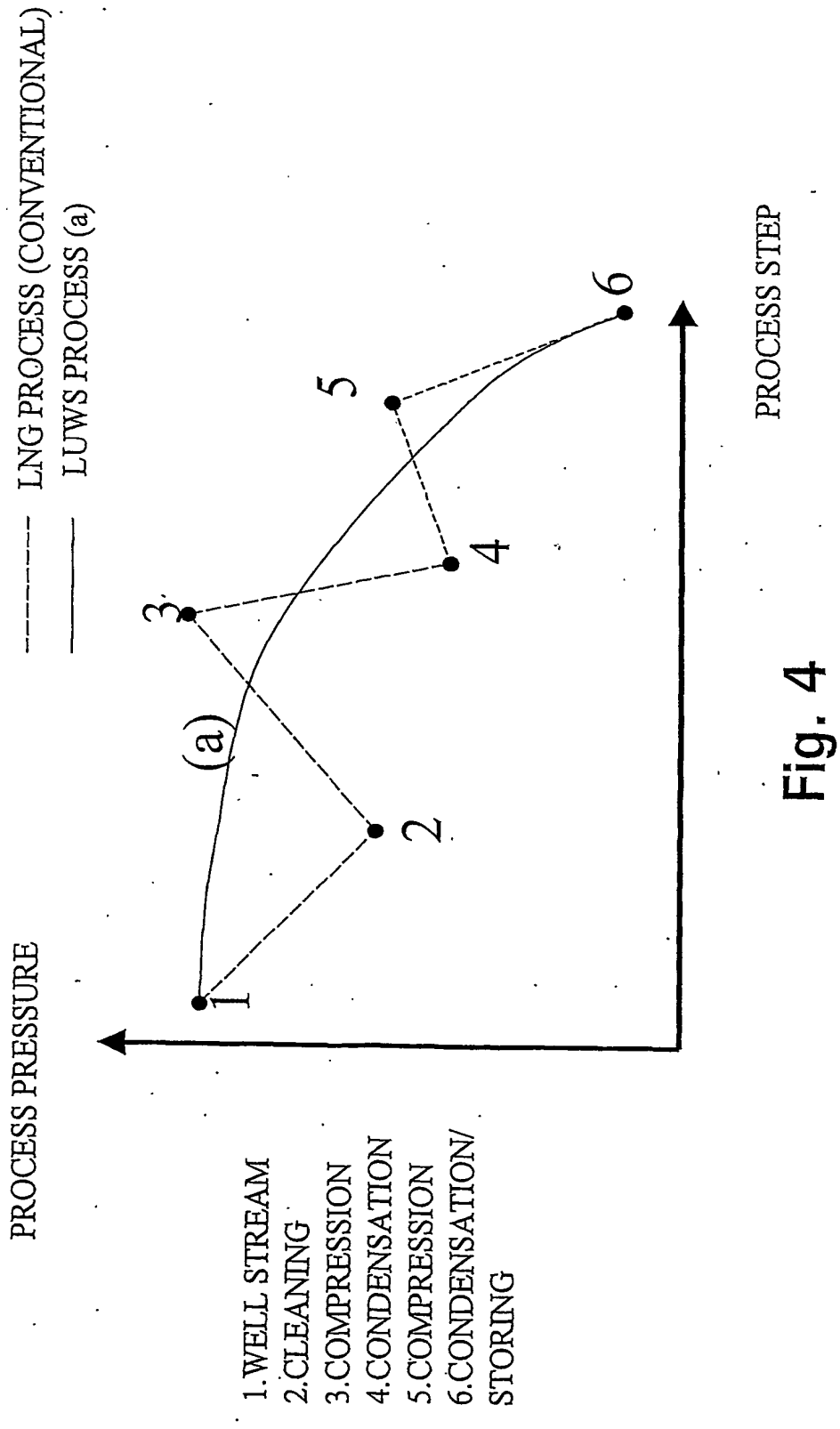

LNG PROCESS (CONVENTIONAL)
LUWS PROCESS (a)
PROCESS PRESSURE
PROCESS STEP
(a)
1
2
3
4
5
6
1.WELL STREAM
2.CLEANING
3.COMPRESSION
4.CONDENSATION
5.COMPRESSION
6.CONDENSATION/
STORING

Fig. 4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/NO 2003/000441

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: F25J 1/02, F25J 3/06, B63B 22/02
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: F25J, B63B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-INTERNAL, WPI DATA, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 6085528 A (R.M. WOODALL ET AL), 11 July 2000 (11.07.2000), column 8, line 53 - column 10, line 22, figures 1,2	1-10
A	WO 9617766 A1 (DEN NORSKE STATS OLJESELSKAP A.S.), 13 June 1996 (13.06.1996), whole document	1-10
A	US 6378330 B1 (M. MINTA ET AL), 30 April 2002 (30.04.2002), whole document	1-10

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
8 March 2004	10 -03- 2004
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Inger Löfving / MRo Telephone No. +46 8 782 25 00

Form PCT/ISA/210 (second sheet) (January 2004)

US	6085528	A	11/07/2000	AU	1721800	A 31/07/2000
				AU	5704199	A 27/03/2000
				CA	2342830	A 16/03/2000
				EP	1109814	A 27/06/2001
				JP	2002524460	T 06/08/2002
				US	6077841	A 20/06/2000
				WO	0014088	A 16/03/2000
				AT	409270	B 25/07/2002
				AT	410418	B 25/04/2003
				AT	907498	A 15/09/2002
				AT	907698	A 15/11/2001
				AU	732004	B 12/04/2001
				AU	733528	B 17/05/2001
				AU	733606	B 17/05/2001
				AU	733821	B 24/05/2001
				AU	734119	B 07/06/2001
				AU	734121	B 07/06/2001
				AU	738861	B 27/09/2001
				AU	739054	B 04/10/2001
				AU	7978298	A 04/01/1999
				AU	7978798	A 04/01/1999
				AU	7978898	A 04/01/1999
				AU	8151398	A 04/01/1999
				AU	8152298	A 04/01/1999
				AU	8152498	A 04/01/1999
				AU	8152598	A 04/01/1999
				AU	8259898	A 04/01/1999
				BG	63827	B 28/02/2003
				BG	63886	B 30/04/2003
				BG	63953	B 31/07/2003
				BG	64011	B 30/09/2003
				BG	103996	A 29/12/2000
				BG	103998	A 29/12/2000
				BG	104000	A 29/12/2000
				BG	104001	A 29/12/2000
				BG	104002	A 29/12/2000
				BR	9810056	A 12/09/2000
				BR	9810066	A 26/09/2000
				BR	9810198	A 29/08/2000
				BR	9810200	A 08/08/2000
				BR	9810201	A 12/09/2000
				BR	9810203	A 05/09/2000
				BR	9810212	A 08/08/2000
				BR	9810221	A 08/08/2000
				CA	2292707	C 30/12/2003
				CH	693769	A 30/01/2004
				CN	1088120	B 24/07/2002
				CN	1088121	B 24/07/2002
				CN	1114808	B 16/07/2003
				CN	1126928	B 05/11/2003
				CN	1126929	B 05/11/2003
				CN	1131982	B 24/12/2003
				CN	1261299	T 26/07/2000
				CN	1261429	T 26/07/2000
				CN	1261430	T 26/07/2000

INTERNATIONAL SEARCH REPORT

Information on patent family members

27/02/2004

International application No.
PCT/NO 2003/000441

US	6085528	A	11/07/2000	CN	1261924	T	02/08/2000
				CN	1261925	T	02/08/2000
				CN	1261951	T	02/08/2000
				CN	1261952	T	02/08/2000
				CN	1270639	T	18/10/2000
				CN	1405485	A	26/03/2003
				DE	19882478	T	15/06/2000
				DE	19882479	T	09/08/2001
				DE	19882480	T	21/06/2000
				DE	19882481	C,T	20/03/2003
				DE	19882488	T	03/08/2000
				DE	19882491	T	27/07/2000
				DE	19882492	T	31/05/2000
				DE	19882495	T	20/07/2000
				DE	29824939	U	26/06/2003
				DK	174555	B	02/06/2003
				DK	174634	B	28/07/2003
				DK	174801	B	24/11/2003
				DK	174841	B	15/12/2003
				DK	179899	A	18/02/2000
				DK	181399	A	17/12/1999
				DK	182099	A	20/12/1999
				DK	182199	A	20/12/1999
				DK	182299	A	20/12/1999
				DK	182399	A	20/12/1999
				DK	182499	A	20/12/1999
				DK	182599	A	20/12/1999
				EG	21914	A	30/04/2002
				EG	22049	A	30/06/2002
				EP	0988497	A	29/03/2000
				EP	0990105	A	05/04/2000
				EP	1017531	A,B	12/07/2000
				EP	1019560	A	19/07/2000
				EP	1021581	A	26/07/2000
				EP	1021675	A	26/07/2000
				EP	1021689	A	26/07/2000
				EP	1021690	A	26/07/2000
				ES	2167196	A,B	01/05/2002
				ES	2170629	A	01/08/2002
				ES	2170630	A	01/08/2002
				ES	2184544	A	01/04/2003
				ES	2186464	A	01/05/2003
				ES	2187228	A	16/05/2003
				ES	2188307	A	16/06/2003
				ES	2197720	A	01/01/2004
				FI	992679	A	18/02/2000
				FI	992680	A	18/02/2000
				FI	992701	A	17/02/2000
				FI	992702	A	14/01/2000
				FI	992703	A	17/02/2000
				FI	992704	A	17/02/2000
				FI	992705	A	31/12/1999
				FI	992706	A	16/12/1999
				GB	0118656	D	00/00/0000
				GB	0118664	D	00/00/0000

INTERNATIONAL SEARCH REPORT

Information on patent family members

27/02/2004

International application No.
PCT/NO 2003/000441

US	6085528	A	11/07/2000	GB	2341130	A,B	08/03/2000
				GB	2341614	A,B	22/03/2000
				GB	2344415	A,B	07/06/2000
				GB	2344640	A,B	14/06/2000
				GB	2344641	A,B	14/06/2000
				GB	2345123	A,B	28/06/2000
				GB	2346382	A,B	09/08/2000
				GB	2346954	A,B	23/08/2000
				GB	2361525	A,B	24/10/2001
				GB	2361526	A,B	24/10/2001
				GB	9930045	D	00/00/0000
				GB	9930046	D	00/00/0000
				GB	9930049	D	00/00/0000
				GB	9930050	D	00/00/0000
				GB	9930052	D	00/00/0000
				GB	9930055	D	00/00/0000
				GB	9930057	D	00/00/0000
				GB	9930090	D	00/00/0000
				HR	980347	A,B	28/02/1999
				HR	980348	A,B	28/02/1999
				HU	222696	B	29/09/2003
				HU	222764	B	28/10/2003
				HU	0002816	A	28/12/2000
				HU	0002890	A	28/02/2001
				HU	0003115	A	29/01/2001
				HU	0003430	A	28/02/2001
				HU	0003580	A	28/04/2001
				HU	0004044	A	28/04/2001
				HU	0004079	A	28/04/2001
				ID	23882	A	00/00/0000
				ID	24059	A	00/00/0000
				ID	24334	A	00/00/0000
				ID	24386	A	00/00/0000
				ID	24478	A	00/00/0000
				ID	24751	A	00/00/0000
				ID	25606	A	00/00/0000
				ID	27349	A	00/00/0000
				IL	133329	A	24/06/2003
				IL	133330	A	24/06/2003
				IL	133331	A	24/06/2003
				IL	133332	A	24/06/2003
				IL	133333	D	00/00/0000
				IL	133334	A	24/06/2003
				IL	133335	D	00/00/0000
				IL	133337	A	29/05/2003
				JP	2001508705	T	03/07/2001
				JP	2001508727	T	03/07/2001
				JP	2001508857	T	03/07/2001
				JP	2001515574	T	18/09/2001
				JP	2002508054	T	12/03/2002
				JP	2002508055	T	12/03/2002
				JP	2002510382	T	02/04/2002
				JP	2002513446	T	08/05/2002
				NO	312167	B	02/04/2002
				NO	312263	B	15/04/2002

US	6085528	A	11/07/2000	NO	312317	B	22/04/2002
				NO	313305	B	09/09/2002
				NO	996276	A	11/02/2000
				NO	996277	A	21/02/2000
				NO	996326	A	16/02/2000
				NO	996327	A	21/02/2000
				NO	996355	A	21/02/2000
				NO	996356	A	21/02/2000
				NO	996357	A	21/02/2000
				NO	996358	A	21/02/2000
				NZ	502040	A	29/06/2001
				NZ	502042	A	29/09/2000
				NZ	502043	A	29/06/2001
				NZ	502044	A	29/09/2000
				NZ	502045	A	22/12/2000
				NZ	502047	A	27/07/2001
				NZ	502048	A	01/02/2002
				PL	337425	A	14/08/2000
				PL	337524	A	28/08/2000
				PL	337530	A	28/08/2000
				PL	337532	A	28/08/2000
				PL	337852	A	11/09/2000
				PL	338124	A	25/09/2000
				PL	339553	A	18/12/2000
				PL	343895	A	10/09/2001
				RO	118331	B	30/04/2003
				RO	118483	B	30/05/2003
				RO	118727	B	30/09/2003
				RU	2195611	C	27/12/2002
				RU	2204094	C	10/05/2003
				RU	2205246	C	27/05/2003
				RU	2205337	C	27/05/2003
				RU	2208747	C	20/07/2003
				RU	2211876	C	10/09/2003
				RU	2211877	C	10/09/2003
				SE	518777	C	19/11/2002
				SE	520133	C	27/05/2003
				SE	521594	C	18/11/2003
				SE	521642	C	18/11/2003
				SE	522014	C	07/01/2004
				SE	0302202	A	13/08/2003
				SE	9904515	A	10/12/1999
				SE	9904529	A	13/12/1999
				SE	9904574	A	18/02/2000
				SE	9904575	A	10/02/2000
				SE	9904611	A	16/12/1999
				SE	9904612	A	16/12/1999
				SE	9904633	A	17/12/1999
				SE	9904634	A	17/12/1999
				SI	20153	A	31/08/2000
				SI	20162	A	31/08/2000
				SK	171999	A	11/07/2000
				SK	172099	A	14/08/2000
				SK	178099	A	07/11/2000
				SK	178199	A	07/11/2000

US	6085528	A	11/07/2000	SK	178299	A	12/02/2001
				SK	178399	A	12/09/2000
				SK	178599	A	12/09/2000
				SK	178799	A	07/11/2000
				TR	9903167	T	00/00/0000
				TR	9903168	T	00/00/0000
				TR	9903169	T	00/00/0000
				TR	9903170	T	00/00/0000
				TR	9903171	T	00/00/0000
				TR	9903172	T	00/00/0000
				TR	9903173	T	00/00/0000
				TR	9903174	T	00/00/0000
				TR	200201918	T	00/00/0000
				TW	387832	B	00/00/0000
				TW	396253	B	00/00/0000
				TW	396254	B	00/00/0000
				TW	444109	B	00/00/0000
				US	5950453	A	14/09/1999
				US	6016665	A	25/01/2000
				US	6023942	A	15/02/2000
				US	6047747	A	11/04/2000
				US	6058713	A	09/05/2000
				US	6114656	A	05/09/2000
				US	6203631	B	20/03/2001
				WO	9858758	A	30/12/1998
				WO	9859084	A	30/12/1998
				WO	9859085	A	30/12/1998
				WO	9859164	A	30/12/1998
				WO	9859195	A	30/12/1998
				WO	9859205	A	30/12/1998
				WO	9859206	A	30/12/1998
				WO	9859207	A	30/12/1998
				ZA	9805331	A	20/12/1999
				ZA	9805334	A	12/01/2000
				US	5890891	A	06/04/1999
				DE	29810449	U	13/08/1998
				US	6038923	A	21/03/2000
WO	9617766	A1	13/06/1996	AU	4273196	A	26/06/1996
				CA	2207090	A	13/06/1996
				GB	2310844	A,B	10/09/1997
				GB	9711776	D	00/00/0000
				NO	180469	B,C	13/01/1997
				NO	944755	A	10/06/1996
				US	5878814	A	09/03/1999

US	6378330	B1	30/04/2002	AU	2092801	A	25/06/2001
				BR	0016439	A	01/10/2002
				CA	2394193	A	21/06/2001
				CN	1409812	T	09/04/2003
				EG	22687	A	30/06/2003
				EP	1248935	A	16/10/2002
				JP	2003517561	T	27/05/2003
				NO	20022846	A	12/08/2002
				TR	200201576	T	00/00/0000
				TW	498151	B	00/00/0000
				WO	0144735	A	21/06/2001